REVIEW ARTICLE

Execute of Chemotherapy Medicines on Cancer Patients

M. V. Muley, Sunita N. Vaidya, V. N. Satote, V. Gulghane, S. Kale, S. Waghade

Department of Pharmaceutics, Datta Meghe College of Pharmacy Salad (H), Data Meghe Institute of Higher Education and Research (D.U.), Wardha, Maharashtra, India

Abstract

Chemotherapy still has several side effects that might lower a patient's quality of life, despite improvements in chemotherapeutic techniques and drugs. This review's objective is to identify and characterize the adverse effects that are unique to chemotherapy. This essay provides a thorough analysis of the major side effects that have an impact on chemotherapy patients' overall health. Cancer patients also encounter a wide range of symptoms, both physical and psychological. These symptoms can be a result of the sickness or the medication and can vary in frequency, severity, and level of distress.

Key words: Alopecia, cancer, chemotherapy, complications

INTRODUCTION

When developing a treatment plan for patients undergoing active management of their cancer, the three main treatment options – surgery, radiotherapy, and medication – are taken into account. The treatment's objectives are:

1. Eradicate the disease: Cure the patient
2. If eradication is not possible, regulate the disease: Incite a mission and extend survival
3. If neither eradication nor control of the disease is possible, control the symptoms.

The various types of medication therapy for cancer include:

Biological therapy is followed by chemotherapy and hormone therapy. Cytotoxic agents, or chemotherapy, are medicines that kill dividing cells and are used to treat cancer.[1]

Objectives of chemotherapy

Chemotherapy must be administered in phases for malignancies such as lymphomas and leukemias. One may look for a remedy with vigorous treatment to completely cure the illness for a lengthy time.

This curative strategy may include the following elements for leukemias:

1. Remission induction: Therapy administered with the goal of increasing cell deaths.
2. Consolidation (sometimes referred to as intensification or postremission therapy): Treatment to eliminate any clinically undetectable disease and to reduce the tumor cell to a level at which host immunological defenses may keep the cells under control.
3. Maintenance: Treatment administered at lower doses with the goal of preserving or extending a remission.
4. Based on chemotherapy's proven benefits in comparison to other treatments such as surgery or radiation, solid tumors may be treated using one or more chemotherapy strategies.
5. Following surgery, adjuvant chemotherapy is administered final treatment, such as surgery, to eradicate any disease that remains or unnoticed micrometastases.
6. Neoadjuvant chemotherapy is used to lessen the tumor burden before to definitive therapy, such as radiation or surgery.
7. Palliative therapy is typically administered when total tumor eradication is thought to be unlikely or the patient declines aggressive therapy. Palliative chemotherapy may be administered to shrink the tumor, slow its growth, and improve symptoms.

Address for correspondence:
Sunita N. Vaidya, Datta Meghe College of Pharmacy Salad (H), Data Meghe Institute of Higher Education and Research (D.U.), Wardha, Maharashtra, India.
E-mail: sunitavaidya06@gmail.com

Received: 01-11-2023
Revised: 12-12-2023
Accepted: 22-12-2023

8. Salvage chemotherapy is used in an effort to put a patient into remission when other treatments have failed. Drugs that fight cancer.[2]

CYTOTOXIC MEDICINES; OVERALL TOXICITY

Chemotherapy is an important part of many cancer treatments, and new anticancer medications are among the most promising. Major fields of pharmaceutical development. However, because of the nature of chemotherapy, it also kills healthy cells while killing cancer cells, resulting in side effects. Chemotherapy side effects have an impact on an individual's physical health, quality of life (QOL), and emotional state. A reduction in the intensity of chemotherapy dose can be used to treat a side effect, and there is evidence that individuals who receive low-dose chemotherapy have lower survival rates.[3] The majority of cytotoxic medications have a greater impact on quickly multiplying cells because the nucleic acids and their precursors are the most important targets of action, and rapid nucleic acid synthesis occurs during cell division. Many malignancies, particularly large solid tumors, have a reduced growth percentage (lower growth rate). Compared to normal gonads, epithelium linings, reticuloendothelial system, and bone marrow, a reduced percentage of cells is in division. Most medications have a dose-dependent effect on these tissues in particular, but there are variances in each member's susceptibility.

Bone marrow

Granulocytopenia, agranulocytosis, thrombocytopenia, and aplastic anemia are caused by bone marrow depression. The most severe toxicity, it frequently restricts the dose that can be used. The usual consequences include bleeding and infections.

Tissue lining lymphoid

Organ immunity mediated by both cells and humoral systems is suppressed as a result of lymphocytopenia and impaired lymphocyte activity. Opportunistic infections caused by low-pathogenicity organisms are particularly significant. Infections caused by viruses (herpes zoster, cytomegalovirus), fungi (Candida and others that cause deep mycosis), and *Pneumocystis jirovecii* (a fungus). Moreover, toxoplasma is mostly observed in patients using anticancer medications.[4]

The mouth

Because of the fast epithelial cell turnover in the oral mucosa, cytotoxic medicines can produce serious side effects. There are numerous chemotherapy medications, especially fluorouracil, methotrexate, daunorubicin, and doxorubicin. Stomatitis could develop as a first sign of poisoning. Chewing frequently causes small trauma to the gums and oral mucosa, and breaches are frequent. The extensive oral microbiota might cause infection. The drug's neutropenia and immune system suppression indirectly raise the risk of oral infections. Gum bleeding can be a symptom of thrombocytopenia. Dental caries may advance quickly due to xerostomia brought on by the medication.[5]

Gastrointestinal toxicities (GIT)

Due to a slowing down in the pace of regeneration of the colon, diarrhea, mucosal shedding, and hemorrhages ensue. Digestive tract's mucus lining. The following medications are known to frequently induce mucositis: fluorouracil, actinomycin D, daunorubicin, bleomycin, and daunorubicin, as well as methotrexate. With many cytotoxic medicines, nausea and vomiting are common side effects. This is because the medication directly stimulates chemoreceptor trigger zone (CTZ) and also causes the upper G.I.T. and other regions to produce emetic impulses and mediators

Skin

Alopecia develops as a result of harm to hair follicle cells. Another problem is dermatitis. 4.6: the gonads: inhibition of gonadal cells results in oligozoospermia and impotence in males, whereas amenorrhea and inhibition of ovulation are prevalent in females. Mutagenesis could occur as a result of harm to the germinal cells.[6]

Fetus

Practically, all cytotoxic medications given to pregnant women have severe negative effects on the fetus, including teratogenesis, abortion, and fetal death.

Carcinogenicity

Specifically, secondary malignancies include leukemias, lymphomas, and many years after the use of cytotoxic medicines, and histocytic tumors are more common. This might be caused by the suppression of humoral and cell-mediated neoplasia-blocking factors.[7]

Hyperuricemia

Since uric acid is a by-product of purine metabolism, this results from extensive cell death and is more likely to happen in leukemias and large lymphomas. Urate stones in the urinary system, gout, and acute renal failure can all occur [Table 1]. Allopurinol provides protection by reducing the production of uric acid. Individual medications may also have particular side effects, such as neuropathy from vincristine, cardiomyopathy from doxorubicin, cystitis from cyclophosphamide, and baldness from it.[8]

Table 1: Medications for the treatment and prevention of cancer

Categories of drugs	Examples of drugs
Antimetabolite: AZACITIDINE (VIDAZA). CAPECITABINE XELODA	Fludarabine Cladribine Cytarabine
	Purinethol, 6- Mercapto Pralatrexate FOLOTYN; Pemetrexed ALIMTA;
	Pralatrexate FOLOTYN Pemetrexed ALIMTA Methotrexate (MTX) TREXALL.
Antibiotics:	Daunorubicin DAUNORUBINE
	Bleomycin BLEOXANE Doxorubicin (ADRIAMYCIN),
	Epirubicin (ELLENCE) Mitoxantrone, Idarubicin IDAMYCIN
Agents: That alkylate include busulfan and myleran.	Cyclophosphamide CYTOXAN
	Dacarbazine DTIC-DOME
	Ifosfamide (IFEX)
	Lomustine (CEENU)
	Melphalan (ALKERAN) TEMODAR
Inhibitors of microtubules	Vinblastine
	Vincristine Vinorelbine PFS NAVELBINE
Aromatase inhibitor	Anastrozole ARIMIDEX
	Bicalutamide CASODEX
	Estrogens VARIOUS AROMASIN Exemestane Flutamide
	Goserelin ZOLADEX MEGACE
	Prednisone
	Tamoxifen
	Triptorelin TRELSTAR
Antibodies	Avastin (bevacizumab)
	Cetuximab (ERBITUX)
	Rituximab (RITUXAN)
	Trastuzumab HERCEPTIN
Tyrosine kinase inhibitor	Dasatinib TARCEVA
	Imatinib GLEEVEC
	Nilotinib TASIGNA
	Sorafenib NEXAVAR
	Erlotinib SPRYCEL
Other considerations	Abiraterone Carboplatin
	Cisplatin PLATINOL
	Enzalutamide XTANDI
	Irinotecan ELOXATIN
	Procarbazine MATULANE

COMMON HARMFUL REACTIONS

Many medicines, although not all, can cause severe nausea and vomiting, which is connected to the direct cytotoxic medications' effects on the CTZ. Rarely, after several treatments, individuals may experience anticipated vomiting. The selective 5-HT3 receptor antagonists are quite good at stopping acute emesis, frequently in conjunction with steroids.[9]

Alopecia is a frequent side effect of several cytotoxic medications, but not all of them. After the chemotherapy regimen is through, hair grows back.

When there is fast tumor lysis, such as in the case of leukemias and lymphomas, hyperuricemia, together with the precipitation of clinical gout or renal failure, may make it more difficult to treat these highly chemosensitive tumors. The xanthine oxidase inhibitor allopurinol may be used to prevent gout, although caution should be exercised when azathioprine or mercaptopurine are administered concurrently.[10]

The digestive system from the mouth to the antrum has a quick turnover, making it potentially vulnerable to negative consequences. Some medications might cause mucositis, which can lead to oral or esophageal ulcers. Opportunistic infections, such as thrush, indigestion, abdominal cramps, and diarrhea, are more likely to arise when neutropenia is present.[11]

Suppression of bone marrow. Many cytotoxic medications have a high sensitivity to the bone marrow. Opportunistic infections happen as a result of poor humoral and cell-mediated responses, and neutropenia is a prevalent condition. The patient must be informed that this could happen so they can seek quick specialized medical care if they fall ill while receiving chemotherapy. Neutropenic sepsis must be treated right away since it can be fatal (often in an inpatient environment). Unusual fungal and bacterial infection along with more typical harmful bacteria and viruses, protozoa may also be present. The risk of hemorrhaging may be exacerbated by thrombocytopenia.[12]

Peripheral neuropathy might happen because the longest nerves are typically the ones that are affected the most. The spindle poisons (taxanes and vinca alkaloids) and cisplatin are two examples of how this is typically observed. The most frequent consequences are sensory, although they can also be motor and autonomic.[13]

Fertility issues. Before beginning therapy, this issue must be addressed and the proper course of action done because many cytotoxic drugs cause sterility. On the other hand, birth control is not a given during chemotherapy treatment.

Reactions involving hypersensitivity. From a small itch or rash to anaphylaxis, in terms of severity. The use of steroid and chlorpheniramine premedications, as well as injecting the chemotherapy, helps control mild responses.

Retention of fluid. Mainly, a problem with chemotherapy that uses taxane drugs (paclitaxel and docetaxel) can be decreased by premedication with a steroid (dexamethasone).

Subsequent cancers. Numerous medications target quickly proliferating cells, but they also affect rapidly proliferating normal tissues. They usually happen 10–15 years following therapy. While the dangers differ among agents, alkylating agents carry the greatest risk.

Teratogenicity. Unless necessary and after thorough discussion with the patient, cytotoxic medicines should be avoided during pregnancy as they are typically extremely teratogenic. As a result, chemotherapy patients (and their spouses) who are of reproductive potential should be advised to utilize effective contraception while undergoing treatment.[14]

Cytotoxic medicines: Overall toxicity A lack of hunger, nauseousness vomiting, alopecia, tiredness, somatitis, fever, constipation, Burning mucous membranes, and infection, rash skin, bleeding gums, tooth pain coughing and jaundice, swelling, and queasy feeling.

DISCUSSION

Chemotherapy regimens continue to play essential roles in the treatment of cancer as therapeutic approaches for the disease develop.

Chemotherapy toxicity

The amount of toxicity experienced by normal tissues appears to be associated with both the dose and frequency of antineoplastic medication treatment. Numerous medications target quickly proliferating cells, but they also affect rapidly proliferating normal tissues. Also typical, and it might be dangerous to the patient's life.

Oral and GIT mucositis may result in localized ulceration and discomfort, which increases the risk of sepsis and causes anorexia, malabsorption, weight loss, anemia, and fatigue.

Central and peripheral neurotoxicity brought on by anticancer medications can significantly lower cancer survivors' functional capacity and QOL.

The negative consequences of chemotherapy include nail changes, nausea/vomiting, and exhaustion, with hair loss being the most distressing side effect.

Scalp hair growth: 98% of patients respond well to this. Hair loss in breast cancer patients was explained by 99.9% of patients. Chemotherapy-related hair loss was formerly believed to be entirely reversible in most cases. Eyebrows and eyelashes: 90% of cancer patients experience hair loss in these areas. Nails: 64% of patients had toenail alterations, whereas 78% of patients had severe or moderate changes to their fingernails.[15]

Chemotherapy's common side effects include

There are more than 100 distinct chemotherapy medications, and each one can have a variety of general side effects, including:

1. Bone marrow suppression
2. Anemia (not a common side effect of chemotherapy)
3. Alopecia (a frequent side effect of treatment).

Cardiotoxicity (often seen following chemotherapy) is linked to both older and newer medications and can result.

1. Hypertension and left ventricular dysfunction (CHF)
2. Thromboembolism
3. Cardiac arrhythmias or pericardial thickening.

Symptoms of neurotoxicity following chemotherapy include.

1. Convulsions
2. Cranial and peripheral neuropathy
3. Myelopathy
4. Aseptic meningitis
5. Cerebellar syndrome
6. Encephalitis
7. Stroke
8. The peripheral neuropathy brought on by chemotherapy induced peripheral neuropathy.

Up to 97% of patients using oxaliplatin may experience neurotoxicity, which can present in either an acute or chronic form. Numerous different medication classes can be neurotoxic. These medications include: Vinca alkaloids such as vincristine and podophyllin analogs; DNA alkylating agents (platinum derivatives such as cisplatin, carboplatin, and oxaliplatin); microtubule-targeting (taxanes such as docetaxel and paclitaxel; epothilones like ixabepilone); and other medications like proteasome inhibitors.

Other adverse effects

1. Defects in spermatogenesis (often seen in chemotherapy)
2. Nausea and vomiting, which are three of the most prevalent side effects (during chemotherapy)
3. Include fatigue (a common symptom of chemotherapy)
4. Diarrhea
5. Hand-foot syndrome (also known as Burgdorf response, acral erythema, or palmar-plantar erythrodysesthesia) hepatitis B reactivation.[16]

Toxicity related to several drugs

Cyclophosphamide or ifosfamide-induced hemorrhagic cystitis: before and after receiving cyclophosphamide, patients must maintain a high fluid intake, and they should be advised to periodically empty their bladders. Dysuria and increased frequency of urination are early signs of bladder toxicity. If microscopic hematuria appears, it is best to temporarily cease taking the medication or switch to a different alkylating agent, up fluid intake, and give a urinary analgesic such phenazopyridine. Patients who develop cystitis can utilize the neutralizing medication, mesna. Large blain severe, protracted hematuria. such patients should be kept an eye out for any indications of urinary obstruction and could need a cystoscopy to get any blood clots that are blocking it out. When administered alone, the cyclophosphamide analog ifosfamide can result in acute hemorrhagic cystitis. Bladder toxicity can be avoided using it in conjunction with a series of doses of the neutralizer mesna. Neuropathy Vinca alkaloids and other chemotherapy drugs are to blame for: Several different chemotherapy medicines, vincristine being the most popular one, can result in neuropathy. Sensory, motor, autonomic, or a combination of these types of peripheral neuropathy are all possible. It manifests as paresthesias in the fingers and toes in its mildest form. Rarely, trigeminal or glossopharyngeal neuralgia might manifest as acute jaw or throat discomfort. Bladder mucosa segments may be lost as a result of acute cystitis. Such patients should be kept an eye out for any indications of urinary obstruction and could need a cystoscopy to get any blood clots that are blocking it out. When administered alone, the cyclophosphamide analog ifosfamide can result in acute hemorrhagic cystitis. Bladder toxicity can be avoided by using it in conjunction with a series of doses of the neutralizer mesna neuropathy.

Similar toxicity is produced by other medications in the vinca alkaloid class, taxane pharmaceuticals (docetaxel and paclitaxel), and myeloma treatment therapies (bortezomib and thalidomide). Neurologic symptoms alone are not a justification to discontinue therapy; instead, the severity of the symptoms must be weighed against the objectives of the therapy. However, typically, the choice to stop taking the medication is made in response to the emergence of mild-to-severe paresthesias or motor dysfunction. The most typical vinca alkaloids-related autonomic neuropathy symptom is constipation. Patients using these medications ought to be put on moderate cathartics and other medications; otherwise, an atonic colon could cause serious impaction. Acute intestinal obstruction caused by more serious autonomic involvement can have symptoms that are similar to those of those of an acute abdomen. Bladder neuropathies are rare but can be very serious. Continued vincristine therapy is absolutely prohibited by these two side effects.

Side effects of methotrexate patients with leptomeningeal illness, acute lymphoblastic leukemia, and sarcomas frequently get the folate antagonist methotrexate as part of their treatment regimens. The kidneys remove methotrexate almost totally. Myelosuppression and mucositis are side effects of methotrexate toxicity that affect cells with a quick turnover, such as bone marrow and mucosa. In addition to harming the kidney and liver, methotrexate can also cause high serum levels of creatinine and liver enzymes. High-dosage methotrexate would be fatal without "rescue" of the normal tissues, which is typically defined as a dose of 500 mg/m^2 or more given over 4–36 h. Tocounteract the harmful effects of methotrexate, a type of folate called leucovorin is administered. Until serum methotrexate levels are in the safe range (<0.05 mmol/L).[16]

Preventive measures

Cardiotoxicity brought on by chemotherapy can be fatal, hence several measures have been taken to lessen and attenuate it. Clinical practice advises close observation and assessment of patient vulnerability to problems after therapy. With several changes in molecular structures, early discovery and appropriate treatment could quickly correct the condition and reduce the risk of cardiotoxicity, including: In investigations on cancer patients, drugs including:

(1) Epirubicin, (2) idarubicin, and (3) mitoxantrone were created and were another enticing alternative because they had equivalent therapeutic efficacy but reduced cardiotoxicity than standard treatments.

Liposomal DOX is another method to lessen the toxicity of the medicine because it can easily pass through more delicate tumors, whereas being restricted to areas with tight capillary junctions, such as the heart's wall.

Dexrazoxane is the sole the Food and Drug Administration-approved cardioprotective drug against cardiotoxicity brought on by anthracyclines while rapidly penetrating the vascular. Dexrazoxane's clinical use is restricted to a few specific patient populations due to the potential risk of secondary tumor development and dexrazoxane's interference with anticancer activity. These patients include adult breast cancer patients who have received cumulative doses of at least 300 mg/m^2 doxorubicin or 540 mg/m^2 epirubicin11.

Chemotherapy's side effects can sometimes have a specific pharmacological cause. Maintaining a high fluid output can prevent this, as can using the medication mesna (mercaptoethone sulfonate), which conjugates these metabolites to promote safe excretion. Hemorrhagic cystitis with cyclophosphamide is a result of the urinary excretion of irritating metabolites, such as acrolein.

Granulocyte colony-stimulating factor (G-CSF) therapy was linked to quicker bone marrow regeneration, with a strong inverse relationship between G-CSF and the length of neutropenia. The mean length of hospitalization as well as chemotherapy-induced neutropenia and febrile neutropenia was observed to have significantly decreased. Other

researchers have provided evidence of these benefits. The cooling strategy of using the scalp for alopecia was indicated in the study.

A recent study on urological cancer patients reported a positive outcome when G-CSF was administered. The use of zolpidem, a hypnotic agent, improves sleep and QOL for breast cancer survivors with hot flashes associated with the sleep disorder, but treatments for sleep may be important to improve strategies to improve well-being. It was effective in 52% of cases and contributed to the improvement of well-being and QOL. To reduce heat flashes, research promoting the use of a number of medications, such as clonidine, gabapentin, and selective norepinephrine and serotonin reuptake inhibitors. A novel method to lessen this toxicity has discovered, called the stellate ganglion block. The use of hormone replacement therapy is another option. The authors stress the idea of using hormones solely for postmenopausal breast cancer patients who have hormone receptor-positive disease.

As a result, a new family of antiemetic medications was created, including aprepitant, an antagonist of the neurokinin-1 receptor. In cisplatin-based chemotherapy, the combination of aprepitant to 5-HT3 receptor antagonist and dexamethasone significantly lowers immediate and delayed emesis. In patients receiving a combination of an anthracycline and cyclophosphamide-based regimen, this three-drug combination has also been explored, and these trials were financed by pharmaceutical firms.[17]

CONCLUSION

It was difficult to receive chemotherapy treatment, and the side effects had an adverse influence on their bodies and minds. The acute side effects of their treatment were managed by actively coping with discomfort and accepting unpleasant effects in the hopes of a cure. Many symptoms are present in chemotherapy patients with cancer. These can be useful for nurses and other medical professionals who want to learn more about these symptoms. For nurses to be able to provide specialized nursing care, they must be able to assess the symptoms cancer patients feel. The best course of action should be included in their nursing care plan to treat the most upsetting symptoms. In addition, assessments should consider the frequency, seriousness, and distress of symptoms while also assisting individuals to discern if a symptom is brought on by cancer or its therapy. The adverse effects of chemotherapy that local cancer patients frequently encounter. Despite being wellcharacterized, these symptoms' high incidence and negative effects on patients' QOL and psychosocial aspects warranted attention. In this regard, pharmacists were well-regarded as patient educators. In fact, research on patients' perceptions and informational requirements could be a useful tool for clinical pharmacists to manage side effects. To combat the difficulties brought on by chemotherapy in cancer patients, preventative care must be used.

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Source of Support: Nil. **Conflicts of Interest:** None declared.